THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 147.

THE CLERAC TUBE CONTROVERSY.

THE interesting controversy which has been going on in our pages of late may now be regarded as practically closed. It was opened by a letter from Professor Hughes, calling attention to a statement made by Professor Barrett at a lecture given by him on Edison's inventions at the London Institution, and reported in the *Times* of January 2nd, to the effect that "no trace" of Clerac's Tube could be found. Professor Hughes stated that he had used Clerac's tube, a powdered carbon rheostat, variable by pressure, since 1866, and invited Professor Barrett to see one still in his possession. Count du Moncel also drew attention to a paper of Professor Barrett's in *Good Words* for October, 1878, in which M. Clerac gets full credit for his tube. Professor Barrett replied that he did not doubt that Professor Hughes possessed one of Clerac's variable carbon rheostats, but that that fact did not amount to publication "in a scientific sense"; that he had searched in vain for a published account of Clerac's Tube, and had only been able to find mention of it in the *Journal Télégraphique* for March 25, 1874, in connection with a prior controversy, in which Professor Zetzsche held that rheostats of powdered carbon had been used in Germany in 1865, before Clerac's was introduced there by Professor Hughes in 1866. Clerac's tube was here simply described as a rheostat of powdered carbon compressed, no mention of variability being made. Professor Barrett also gave a quotation from a private letter of Mr. Edison, in which Mr. Edison states that he tried tubes similar to M. Clerac's with carbon in every degree of subdivision, but could get no apparatus to detect the change of resistance produced by pressure, and, hence, doubted the existence of the rheostat in question. The fact, however, that Mr. Edison could not make these tubes does not prove their non-existence, although he seems to think so; and, moreover, it is curious to compare the authorised description of his "Pressure Relay" published in the *Journal of the Telegraph* for June 1, 1877. "He (Mr. Edison)," says this account, "takes advantage of the property which plumbago possesses of decreasing its resistance enormously under slight pressure." Now this plumbago is a material used in Clerac's Tube, and it is a singular fact that it should possess one set of properties when used in Edison's Pressure Relay and another when employed in Clerac's Tube. There appears to be an uncertainty in the manufacture of powdered carbon resistances which lowers their practical value. Dr. C. W. Siemens recently stated, for instance, that he had quite failed to make carbon resistances which gave the wide variations of resistance obtained by Mr. Edison. He attributed the fact, however, to his own want of skill, and it does not seem to have occurred to him to deny the existence of Edison's carbons because he himself had not been able to construct them. In the same letter Professor Barrett called for Professor Hughes' evidence as to Clerac's Tube.

Professor Hughes replied by producing the results of an enquiry instituted by M. Cochery, the French Minister of Posts and Telegraphs, which comprised among others, a letter from Professor Hughes to M. Clerac, bearing the Paris postmark for March 10, 1866, in which the tube is alluded to, and a letter from M. Hardy, the eminent French electric-mechanician, in which he attests to resistances of carbon meant to be varied by pressure, were constructed for M. Clerac at the end of 1865 or beginning of 1866. M. Clerac also explained that the reason why the tube was not more fully described in the *Journal Télégraphique* for March 25, 1874, was that such a description was not necessary for the purposes of the controversy, and remarked that it is only necessary to see and use the tube to know that it is designed as a variable resistance. A letter from Mr. Despointes, superintendent of the Submarine Telegraph Company, also certified that Professor Hughes had used it in 1871 on the lines of that company. Count du Moncel also drew attention to the fact that long before either M. Clerac or Mr. Edison had discovered the variability of powdered carbon resistances under pressure, he himself had found it out, and published it in the *Comptes Rendus* for December 2, 1872.

Lastly, Professor Barrett, while admitting the conclusiveness of Professor Hughes' evidence as to the existence of Clerac's tubes since 1866, throws doubts upon such evidence as amounting to *publication*, and infers, that although "a resistance tube having some resemblance to Edison's carbon rheostat was doubtless made by M. Clerac, the use now claimed for it was generally unknown." Professor Barrett also admits Count du Moncel's claim to the discovery in dispute.

From the above summary it will be seen that the controversy shifted its ground. It was originally raised by Professor Barrett's statement that "no trace of Clerac's tube could be found"; but Professor Barrett explained that he did not doubt the

existence of the tube, and it became a question of publicity. As regards the first point it is, perhaps, to be regretted that Professor Barrett did not make a more qualified statement than that "no trace of Clerac's tube could be found," since an audience hearing these words would be liable to conclude that the story of the existence of these tubes was a myth. That this could not be the intention of Professor Barrett appears from his avowal of belief in the tubes possessed by Professor Hughes. Had he said in his lecture that "no trace of the publication of Clerac's tube could be found," it seems to us that he would have done more justice both to himself and to M. Clerac. Be this as it may, however, the major point at issue is the question of publicity. M. Clerac does not appear to have published a scientific description of his tube in any journal. He is an official of a government administration, which discountenances public prominence on the part of its members; and among other reasons he may not have considered the tube of sufficient moment to merit publication of the kind. Indeed it has acquired its recent importance from the microphone dispute. It is clear, however, that these tubes were used in a number of European countries by Professor Hughes, and shewn to the telegraph *employés* there during 1866 and subsequent years. Does this circumstance, taken in conjunction with the fact that public reference was made to them in the *Journal Telegraphique* constitute publication? Legally it would, perhaps, be a nice question to decide, and even if it should be ruled that professional usage to the extent implied in this case, does not amount to publicity, still facts are facts, and it cannot be forgot that Clerac *did* invent these tubes, and that they were made use of by Professor Hughes and others on and after 1866. The branch discussion whether or not Clerac first invented these tubes is beside the present controversy; but it is obvious that if Professor Zetzsche's claimant made carbon pressure rheostats before Clerac, Mr. Edison's title to the invention is still further removed.

The results which may be extracted from the controversy we have been considering are briefly these: that it is to Count du Moncel that the discovery of the variability of the resistance of powdered carbon by pressure in 1856 must be attributed; that a powdered carbon rheostat, made to vary in resistance by application of pressure was invented by M. Clerac in 1865; and that Mr. Edison applied the same property of carbon to the construction of a speaking telephone transmitter; the voice giving the air pressures required. Mr. Edison, probably, re-discovered this property of carbon—no one has implied that he did not—a forbearance which will not pass unmarked when it is contrasted with the harsh imputations which have emanated from America on this subject. It has now been clearly proven, however, that he was anticipated in the discovery; and he will, we feel sure, be propitiating his best fame, if he resigns his claim to priority here and contents himself with his undoubted rights to the remarkable invention of the carbon telephone transmitter.

Of the bearing of this controversy on the invention of the microphone we do not intend to enter. It is either ignorance or wrongheadedness which does not recognise any difference between the carbon-telephone which *does* depend on the variable resistance of *powdered carbon* under pressure, and the microphone which depends on the sensibility of delicate *joints in a conducting circuit*, to the influence of sonorous sounds, and other vibrations. This matter was settled long ago by Sir William Thomson, and there would be nothing gained by dwelling on it now. We may, therefore, conclude by drawing the inevitable but still unheeded moral, that all novel inventions and discoveries should be published to the world.

RISCH'S DOUBLE CURRENT KEY.

THIS form of key is especially adapted for working long lines, as by its use the signals are rendered decided and free from tailing.

The knob is divided into two parts, one on the main lever L^1, and the other on a side lever L mounted on L^1 by an insulating pivot 6, and acted on by a spring 7 so as to keep the two parts of the knob asunder, except when they are closed together by the hand of the operator when he is about to use the key. Until so closed the lever L connected to line by the spring 7 completes circuit from the line to the relay for receiving signals. On closing the knob this circuit is broken, and the line is then put in circuit with the key lever L^1, which by the screw 1 is in circuit with the zinc pole of the battery. On the back part of the key lever L^1 are mounted by pivots *f* and f^1, two side levers A and B, of which A is in metallic contact with L^1, and B is insulated from it; A is drawn by a spring 8 on to the screw 3, which is connected to the zinc pole o the battery, and B is drawn by a spring 9 connected to earth on to the screw 2, connected to the copper pole. Thus when the knob is closed the line is connected to the zinc, and earth to the copper pole. On the lever L^1 are fixed two insulated brackets C and Z, connected respectively to the copper and zinc poles, and having screws 4 and 5 so adjusted that they are just clear of the front ends of the levers B and A, when their back ends rest on 2 and 3.

When the operator having closed the knob depresses it, the following changes of connection take place:—Contact is first broken between 1 and Z, but the lever A maintains connection of line and zinc, and 4 coming in contact with B makes connection to

earth. By farther depression of the key the contacts of A and B with 2 and 3 are broken, and then contact is made at C. In the ascent of the knob a similar series of changes of circuit are effected in reverse order, and thus in both cases the line is discharged in the course of the key's movement, and the discharge is followed up by an impulse of

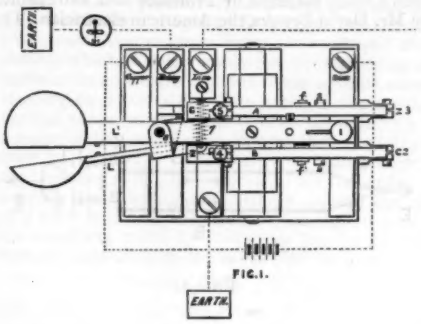


FIG. 1.

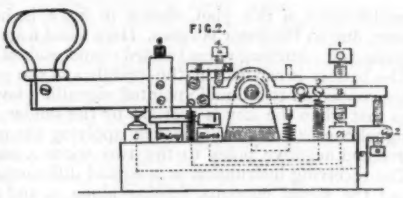


FIG. 2.

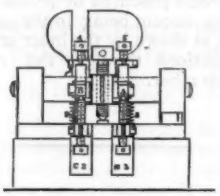


FIG. 3.

the opposite sign to the previous charge, and this gives the receiving instrument or relay a decided action.

The period of discharge may be varied in duration by adjustment of the screws 4 and 5.

AN ELECTRO-MAGNETIC TICKET COUNTER for railways has been adopted at a railway-station in Vienna to number the passengers of each class travelling by any particular train. This is a useful contrivance, and enables the station-master to apportion the proper number of carriages to the traffic.

INDUCTION ON AIR-TELEGRAPH LINES.

EVERY well-versed electrician knows that when two neighbouring telegraph wires are working, the signal currents in one induce feebler but corresponding currents in the other. The effect of these induced currents on a very sensitive receiving instrument, such as the speaking telephone, is to perturb its signal, causing a confused clamour of sounds which quite smothers up the small voice of that instrument. Now the tendency in telegraphy is, of course, to obtain greater speed of working on lines, and in order to do this more sensitive instruments are required. For the retarding effect also of earth induction on current signals, which causes them, as it were, to plough their way along against an influence tending to hold them back, and the wave-like form which the signals assume under this influence, render it necessary to make the receiving instruments more sensitive, so as to appreciate smaller fluctuations of current strength, if greater speed be aimed at. It is evident, however, that there must be a limit to this sensitising of the receiver if the induction of neighbouring currents is to be left uncorrected, for the receiver may be made so sensitive that, like the telephone, it will be perturbed in its action by these induction currents. There is no mechanical obstacle to making receiving instruments which will record 1000 words per minute, could these induced currents be prevented from influencing them. Until the researches which Professor Hughes brought before the Society of Telegraph Engineers last Wednesday (March 12), very little, if anything, had been done by electricians to neutralise the evil. It has hitherto been evaded by them in employing powerful currents to work insensitive instruments, and in having recourse to multiple methods of telegraphy. The time is come, however, in which this question will have to be seriously grappled with by telegraph administrations, and as the sensitive telephone has been the means of bringing back the wandering attention of electricians to the subject, so has it been, in the hands of Professor Hughes, the means of enabling him to give us the first contribution towards a solution of the difficulty.

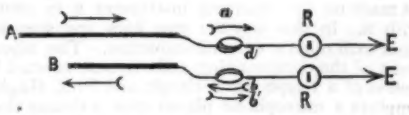


FIG 1.

One of the cures tor current induction suggested by Professor Hughes can be explained by help of fig. 1, where A and B are two neighbouring telegraph lines, one being longer than the other for the sake of generalising the case. Between each line and its receiving instrument R, a coil of wire *a* for line A,

and *b* for line B, is inserted. Now the length of the wire in coil *a* is proportioned to the length of the line A in the same ratio as the length of wire in the coil *b* is proportioned to the wire B, that is, supposing the kinds of wire for each to be similar. The coils themselves are of the same diameter, only *a* will have more turns than *b*, the line A being longer than B. The distance *d*, between these two coils, also bears a relation to the distance between the lines, a relation found by experiment; and if the line A is directly above B the coil *a* should be supported directly above *b* and parallel with it. On the other hand if A be not in a vertical line above B on the telegraph posts but displaced sideways, as on the French lines, then the coil *a* must be displaced laterally to a proportionate extent, while being above it. The coils *a* and *b* thus posed form a compensating arrangement to the mutual induction of the two lines. This induction compensator, as Professor Hughes calls it, can be easily made by causing the coils to slide up and down a vertical stem in the case of wires vertically over each other, and giving them also a lateral motion in the case of wires placed otherwise. It is in fact an artificial land line, just as Muirhead's inductive-resistances are an artificial cable.

We have yet to see how it operates in neutralising the induction. Let us suppose that a signal current is passing in the direction of the arrow, along the line A and the coil *a*, to earth through the receiver R. Now if the coil *a* be wound in the same direction to the coil *b*, this current will evoke an induction current in the reverse direction in the line B and the coil *b*, as shewn by the arrows. This induction current will make a false signal on R if it is, like the telephone, sufficiently sensitive. If, however, the position of the coil *a* be reversed with respect to *b* so that the current circulates round its turns in an opposite direction to what it did in the case we have been considering; the induction of the coil *a* on *b* will be such that an induction current will be set up in *b* in the *same* direction to the primary current through *a*, as shewn by the arrow *b'*. At the same time the induction current in B will remain, as before, in an opposite direction to the primary current in A. But the coils *a*, *b*, have been so proportioned and placed with respect to the lines A, B, that the induction effects in them are equal to those in the lines themselves. Hence the equal but contrary induction currents in B and its coil *b*, neutralise each other and no false signal can be made on the receiving instrument R in circuit with B. In this way the two lines are screened from each other's dynamic-induction. The adjustment of the compensating coils is best effected by means of a telephone in circuit, and Prof. Hughes employs a microphone placed near a ticking clock to give the sonorous currents. The adjustment is made by shifting the coils with respect to each other till no induction sound is heard on the telephone. The insertion of soft iron rods into the hollow of the coils also affects the balance very sensibly; and Professor Hughes finds that according as one or more of these rods are inserted the mutual induction of the coils is more and more lengthened out. By these rods the arrangement can be made to compensate for the length of the induced signal as well as for its intensity.

The plan of using a return wire for telephone circuits in order to overcome the induction clamour is a well-known one; that of enclosing the wire in a conducting envelope in connection with earth, though efficacious in the case of statical electricity, is worthless for dynamic electricity. It occurred to Professor Hughes that the going and returning wire should be twisted round each other; but as was pointed out in a note of our last issue, this plan has been already patented by Professor Bell, and claimed by Mr. David Brooks, the American electrician. The

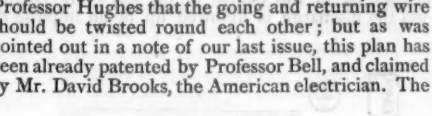


FIG. 2.

modification of this plan, shewn in fig. 2, is, however, due to Professor Hughes. Here A and B are the going and returning wires twisted round each other. The battery is earthed in the middle and the poles are connected to a double pointed signalling key K, so that when the key is worked by the sender, the signal consists of simultaneously applying the positive and negative poles to the two wires A and B. The receiving instrument R is wound differentially, and the signal currents flowing along A and B in the direction of the outer arrows, work the receiver conjointly. On the other hand the equal induction currents produced by primary currents in a neighbouring circuit, being in the same direction in both wires, as shewn by the inner arrows, pass in opposite directions through the receiver and neutralise each other.

A NEW THEORY OF THE EARTH'S MAGNETISM.

AT the latest meeting of the Physical Society, on March 8, Professor Ayrton brought forward a new theory of Terrestrial Magnetism, originated by himself and Professor Perry of the Imperial Engineering College, Japan. It is well-known that metal cages act as screens against induction in the case of static electricity, or electricity at rest, and hence Clerk-Maxwell, at the B. A. meeting for 1876, suggested that no earth connection was necessary for lightning conductors since a cage would be sufficient. But dynamic electricity is different from static in this respect, and Professors Ayrton and Perry found that even a thick block of copper will not screen a coil of wire from the induction of a *current* flowing in a neighbouring one. Some

experiments of Dr. Muirhead, not yet published, would seem to favour the view that a current is a series of intermittent changes of potential, and that the inductive effect is due to a difference in the epochs of the currents in the two coils. It was found by Helmholtz that a quantity of static electricity in mechanical motion performs work. Conversely, Mr. Crooks finds that the stream of molecules from a — pole in vacuo is electrified and may be deflected by a magnet. It is upon this fact that Professors Ayrton and Perry have based their theory, which is easily explained by supposing the earth to be an isolated sphere with a static charge residing on its surface. Then since each electrified particle at the surface will be moving relatively to a point in the interior, it follows that the interior must be magnetic. The theory is independent of the substance of the interior; but in order to simplify the working, the authors treated the case of a solid iron ball, and curiously enough arrived at the result expressed by Biot's law for the distribution of magnetism on the surface of the earth.

$$I^2 = M\sqrt{1 + 3\cos^2\theta},$$

and similarly they found that if the earth were electrified to the potential of 10^8 volts relatively to interplanetary space, its magnetisation would be as it is. If the earth were alone in the universe then, by this theory it would have its own magnetic state by virtue of its electric charge and axial rotation. If other bodies in the universe, however, had their magnetic states too, these would influence the earth's, and hence we should have terrestrial tides and storms of magnetic force, such as are known to exist, as for instance when changes take place in the sun's atmosphere by approach of planets or other causes. Lastly, the iron in the interior of the earth may give it a certain amount of coercitive force, but the theory does not rest on this.

ON THE SPECIFIC INDUCTIVE CAPACITIES OF CERTAIN DIELECTRICS.

By J. E. H. GORDON, B.A. Camb.*

As it would be impossible within the limits of an abstract to give any intelligible account of the new method of experiment (due to Professor Maxwell) which has been employed, I will merely give the table of results, reserving all discussion and explanation until the publication of my paper in full.

I may, however, state that the method is a zero method, that the electrified metal plates never touch the dielectrics, and that the electrification, which is produced by an induction coil, has an electromotive force equal to that of about 2,050 chloride of silver cells, and is reversed some 12,000 times per second.

RESULTS.

Dielectric. Glass, Slabs about 1 in. thick.		K.
Chance's optical glass.	Double extra dense flint	3·1639
	Extra dense flint	3·0536
	Light flint	3·0129
	Hard crown	3·1079

* Proc. of the Royal Society.

Dielectric. Glass, Slabs about 1 in. thick.			K.
Common plate, 2 slabs.	No. 1	3·2581	3·2431
	No. 2	3·2282	
Ebonite, 4 slabs, ¾, ½, ½, ¼ inch.	No. 1	2·2697	2·2838
	No. 2	2·2482	
	No. 3	2·3097	
	No. 4	2·3077	
Best quality gutta-percha			2·4625
Chatterton's compound			2·5474
India-rubber	black		2·2200
	vulcanized		2·4969
Solid paraffin, sp. gr. at 11° C. ·9109. Melting point 68° C. 6 slabs cut in planing machine. Results corrected for cavities.	No. 1	1·9940	Mean ... 1·9936*
	No. 2	1·9784	
	No. 3	1·9969	
	No. 4	2·0126	
	No. 5	1·9654	
	No. 6	2·0143	
Shellac			2·7464
Sulphur			2·5793
Bisulphide of carbon			1·8096†

The following table compares the refractive indices of the transparent dielectrics with the square roots of the specific inductive capacities. In cases where there is a wide difference μ is taken from books on physics; wherever there was a close agreement it was carefully determined by the author, except in the case of paraffin, where the value is that given in Maxwell's "Electricity."

Dielectric.	$\sqrt{K}$.	Nearest value of μ.	Ray for which μ is nearest.
Double extra dense flint glass	1·7783	1·7460	Band in extreme violet in magnesium spark spectrum.
Extra dense flint	1·7474	1·6757	
Light flint ...	1·7343	1·5113	
Hard crown	1·7629	1·5920	
Plate glass ...	1·8009	1·543	
Paraffin	1·4119	1·422	Rays of infinite wave length.
Sulphur	1·6060	2·115	
Bisulphide of carbon	1·3456	1·6114	

[These results are, we understand, a correction of those given before by Mr. Gordon. See TELEGRAPHIC JOURNAL for July 15, 1878.—ED. T. J.]

* Messrs. Gibson and Barclay, "Phil. Trans," 1871, using a method entirely different from mine, obtained K=1·977 for paraffin. Correcting for a slight difference of density, I find that if they had used my paraffin their result would have been 1·9833.

† I am not quite certain of the accuracy of this result.

MAXIM'S ELECTRIC LIGHT.

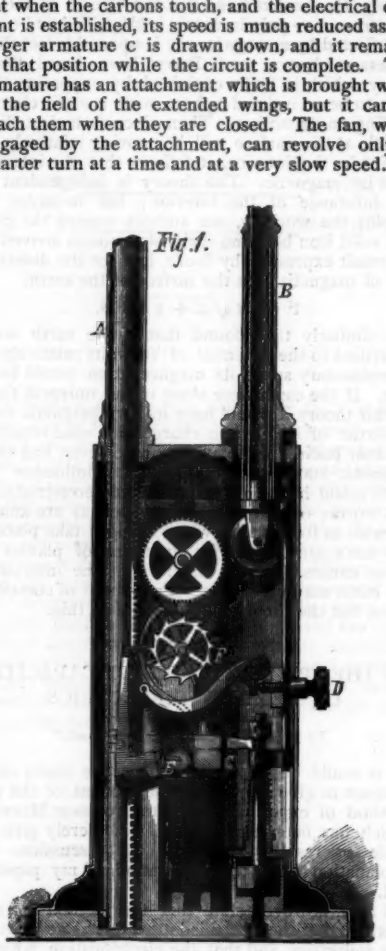
WITHIN a short time past a new dynamo-machine, invented by Mr. Hiram Maxim, of New York, has been brought out, and is now being introduced by the United States Electric Lighting Company. This machine requires 1½ horse-power to drive it. It weighs 300 lbs., and produces a light of from 1,200 to 2,000 sperm candles, according to speed. The magnets are similar in form to those used by Dr. Siemens, of London, but the armature, or revolving portion, is of a new design, which is said to be free from many objections common to other machines. The only points where any considerable wear takes place on these machines are in the commutator, in which a stationary copper brush takes the current from the revolving part.

In some machines this portion has been built into the machine, so that when it is worn the whole machine would require rebuilding in case of repair. Mr. Maxim has constructed his machine so that the removal of a nut loosens the parts subject to wear, so that they may be replaced in a few minutes, and at a trifling cost.

Mr. Maxim has also produced a new lamp, which is shown in the accompanying figures. Fig. 1 represents a vertical section; fig. 2 a perspective of the same, together with some details. A is the positive carbon holder, and B the negative. The operation of the lamp is as follows: The negative carbon which may be 6 inches long, being secured in the lower holder B, the top holder may be drawn up, as the pinion that gears into its rack is free to turn in that direction without driving the train of gears. A carbon 11 inches long may now be inserted in the top holder, and its point brought in line with the lower carbon by moving the lever on the back side of the carrier.

The wires being connected to the binding post (one on each side of the lamp), the thumb nut G, being turned will allow the weight of the positive carrier to rotate the train of gearing, and by winding up a cord to draw the negative upward until the combined movement of both causes the points of the two carbons to meet. This will establish an electrical contact, and the current will at once commence to pass, the electro-magnet in the bottom of the lamp will become excited and draw downward the two armatures, one of which draws down one end of the cord that supports the negative carbon, and the other locks the gearing. The separation of the carbons by this downward movement of the negative establishes the voltaic arc, when the light comes out in all its splendour. As the carbons waste away the arc becomes longer, and the resistance to the passing current becomes greater, its power to excite the electro-magnet correspondingly decreasing. The armature E is drawn away from the magnet by a retractile spring, the tension of which is adjusted by thumb screw D. When the magnetism is so much reduced that the pull of the spring is greater than the pull of the magnet, the spring will force the armatures upward and remove the detent from the ratchet wheel F, thus allowing the train of gears to move so that the carbons slowly approach each other until a point is reached where the arc is shortened sufficiently to again bring the magnet up to its original strength, when it will again pull down the armature and lock the gearing. A too rapid movement of the parts is prevented by a small fan, shown in fig. 2. When the carbons are drawn apart to a considerable distance and then allowed to approach, this fan will revolve with great speed, and its wings will be spread by centrifugal action to their fullest extent; but when the carbons touch, and the electrical current is established, its speed is much reduced as the larger armature C is drawn down, and it remains in that position while the circuit is complete. The armature has an attachment which is brought within the field of the extended wings, but it cannot reach them when they are closed. The fan, when engaged by the attachment, can revolve only a quarter turn at a time and at a very slow speed.

Fig. 1.



When the ratchet F on the fan shaft is unlocked, it can revolve rapidly only when the current is broken, and when it is released to feed the carbons to an already established arc it can only turn at a speed a little faster than the actual consumption of the carbons. Should the arc be broken, or the light be extinguished from a high wind or other cause, the large armature C will be liberated, and by bringing the lower carbon against the upper carbon it re-establishes the arc instantly. A too rapid movement is prevented by a controlling chamber or dash pot in the bottom of the lamp. All of the comparatively heavy work of separating

the carbons and re-establishing the current is done by armature C, while the smaller armature E has only to lock and unlock the train of gearing.

As the distance to be travelled is very slight, and the work to be done so light, but very little change in the electro-motive force of the current is required to stop or start the feeding of the carbons. The tension of the spring that opposes the magnetism can be adjusted from the outside of the case to balance its pressure against a current of any strength. Where great nicety and steadiness are required, this lamp seems well adapted to meet all requirements. It is small and compact, and appears a very substantial and beautiful piece of mechanism.

A less expensive form of lamp has been devised by the same inventor. In this lamp both carbon

Fig. 2.

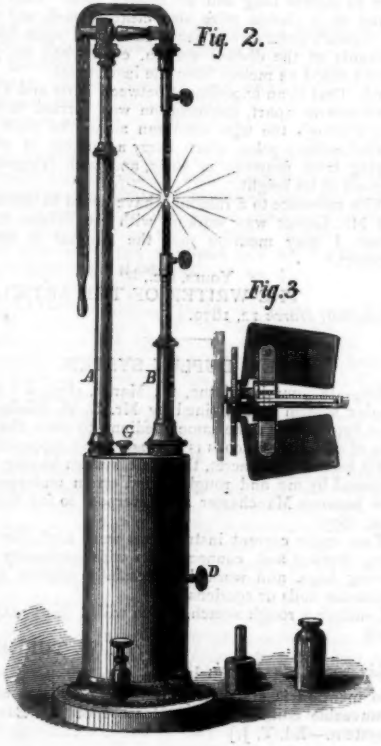


Fig.3

holders are supported by a cord. As the upper or positive holder descends it draws the cord over a pulley and raises the negative just one-half the distance travelled by the positive. When the wires are properly connected and the carbons are in position, the top holder may be allowed to run down until the two carbons meet. This establishes the circuit and excites the axial magnet in the bottom of the case, when the core is drawn into the helix, and the two carbons, through the medium of levers, are drawn apart until the magnetism and tension of the spring balance each other, and as the carbon is burned away the arc is lengthened, the magnetism reduced, when the core is drawn out of the spool, thus feeding the carbons together as they are consumed until the parts have reached a position where the ratchet on the lower lever is beyond the reach of the pawl, then the core descends and the ratchet revolves, when the carbons take a new position, and the feeding goes on as before. The ratchet wheel is prevented from turning more than one tooth at a time by a spring at the end of the lower lever. The pull of the rack is opposed to the spring, and when the pull is reduced by the disengagement of a ratchet tooth the lever, and with it the ratchet, are forced downward, and the succeeding tooth is caught on the pawl. The core on which the magnetism operates is connected with the rack by compound levers, so that by changing the position of the connecting link the leverage can be readily adjusted.—From G. B. PRESCOTT'S *Telephone, Electric Light, &c.*

THE TELEGRAPH IN DENMARK.

By CARL HANSEN, Fredericia, Jutland.

TWENTY-FIVE years have passed since the first Danish electrical telegraph line was opened for public correspondence. It was on the 1st of February, 1854, that a line 280 miles long was opened between the two terminal points, Elsinore and Hamburg; but, besides these two terminal stations, there were intermediate stations at Copenhagen, Corsoer, Nyborg, Fredericia, Flensburg, Rendsburg, and Altona, besides three postal stations of a certain importance. On the 1st of January, 1855, a Danish controlling station was established at Helsingborg, in Sweden, to control the Swedish correspondence that passed through Denmark; a cable having in the meantime been laid out from Vedbek, near Elsinore, to Helsingborg. A wire was then put up from Helsingborg through Seeland, Fione, and the two duchies to Hamburg, where the messages for Germany and England were exchanged. In the year 1856 a new line through the eastern part of Jutland was built between Frederikshavn and Hamburg, and at the same time a short wire was put up from Copenhagen to Frederiksborg. On the new line in Jutland, which was 270 miles long, stations were established in all the greater towns of the east of the Peninsula in the following year, and in Seeland and Fione two new lines were erected, with a station at the town of Odense. In 1858 the controlling station at Helsingborg was removed to Copenhagen as a new line had been erected for the Swedish traffic. Private companies were very active in erecting telegraph communications, and Denmark is indebted to those companies for the many stations that were opened during a short period. These lines were from Nyborg to Svendborg, Rudkjóbing, and Marstal—the two last towns, which are situated on the islands of Langeland and Aeroe respectively, being connected by cables—from Hobro to Skive, Viborg, Nykjóbing on Morse, and Thisted, and the lines from Aarhus to Silkeborg, and from Fredericia to Middeefart and Assens. In 1859 Flensburg was put in direct connection with England *via* Toenning and Vesterhever. A line from Copenhagen to Hamburg, with a two-wire cable from Fione to Als, was established in 1860-61, so as to have more lines for the increasing traffic with foreign countries. In 1861 a new line of a length of 148 miles was built, which connected all the towns of western Jutland from Flensburg to Lemvig; and many new private companies got a licence to erect stations, of which the westerly towns of Seeland were the most important. All these private lines and stations

were bought by the Government on the 1st of February, 1871.

The loss of the duchies of Schleswig and Holstein diminished the total length of the Danish telegraphs by about 400 miles, and the stations by 16, including the two great stations at Flensburg and Hamburg, which were in direct connection with Copenhagen as well as the most important Swedish towns, and forwarded all the traffic abroad from Denmark, Sweden, Norway, and in part also from Finland. Sweden had then no other connection with Germany. At present it has a cable from Trelleborg to Rügen, one from Gothenburg over the northern extremity of Jutland (land wire) to Newcastle, and one from Grislehamn (Stockholm) to Nystad Finland—the two last belonging to the Great Northern Telegraph Company.

The war of 1864 with Germany for some time kept all development of the Danish telegraph system at a standstill; but a few years after, in 1869, the work commenced again by connecting Bornholm into the system. Meanwhile, cables were laid down to England (Newbiggin, near Newcastle) in 1868, and to Norway (Arendal) in 1867. In 1869 the Great Northern Telegraph Company connected Russia (Libau) with Fredericia *via* Bornholm (land line on this isle). Fredericia now became the head office for the traffic to and from these countries; and in 1873 it was also connected by a great Great Northern cable with Calais *via* Fanó, and with Gothenburg *via* Frederikshavn. New lines between small towns had also been built, and the three following semaphoric stations were installed: viz., Hirtshals (Skagerak), Hanstholm (North Sea), and Hammershus on Bornholm, as well as four stations, which are only open in severe winters for postal use; viz., Masnedó, Sprogó, Knudshoved, and Slipshavn.

Copenhagen has a great local traffic, but is of little importance as a transit office. It is Fredericia that must be regarded as the most important of all the telegraph stations in Northern Europe, from an international point of view. No other town is, as far as I can learn, connected with so many foreign countries through cables as this cosy little Danish town. For this reason the *employés* must know and speak several languages to a certain degree of proficiency, for they correspond with Paris, *via* Calais; with Newcastle, *via* Newbiggin; with Russia, *via* Liban; with Sweden, *via* Gothenberg; with Norway, *via* Arendal; and, finally, with Germany, *via* Hamburg, Flensburg, and several other towns. Most of the telegraphic traffic between Russia, China, Sweden, and Norway (the French and German) on one side, and England, France, and a portion of the United States' traffic to China on the other, pass through this town, which is unknown to the world at large. At Fredericia there are about 70 clerks, and 30 to 40 instruments, of which the most part are inkwriters of Siemens-Halske's improved system. The cables are worked by Wheatstone's instrument.

The Danish telegraph lines comprise 1789·64 English miles, including 4790·84 miles of wire. The whole staff at the end of last year numbered 360, of which there are two engineers; 17 managers or superintendents, who control the larger stations; 25 clerks-in-charge, of whom many are managers of smaller stations; 128 clerks divided into 5 classes; 104 beginners; and 90 postmasters or other people who have a station to take care of, but have other business besides.

The Swedish telegraph, including land lines and cables, amounts to 776·2 Swedish miles, comprising 1904·7 Swedish miles of wire. The total number of Government stations and railway stations is 705, of which 179 are Government and the remainder are railway stations.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

GOWER'S TELEPHONE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In an article on the above in your last issue, I stated (wishing to be rather *under* than *over* the mark in my estimate of its powers) that words imparted at the sending end were audible several yards from the receiving telephone. My attention has now been called by the inventor to the following facts:—

1st. That at a recent meeting of the *Societe d'Encouragement* talking was distinctly heard all over a room 20 metres long and 10 metres wide. That airs played on a clarion were also clearly heard, and that Mr. Gower's orders were heard and acted upon by his assistants at the distant station, even when he (Mr. Gower) stood 12 metres from the instrument.

2nd. That in an experiment between Paris and Creil, 51 kilometres apart, conversation was carried on with ease, although the wire used ran along the main line (Paris-London) poles, which carry a number of wires, varying from fourteen to forty, and with telegraphic business at its height.

With reference to a rumour I have heard to the effect that Mr. Gower was working with the Edison transmitter, I may mention that the rumour is utterly incorrect.

Yours, &c.,
THE WRITER OF THE ARTICLE.

London, *March* 12, 1879.

A NEW DUPLEX SYSTEM.

SIR,—In your last issue, 1st March, 1879, a "new" Duplex system is explained by Mr. S. M. Banker. I must beg, through the same medium, to state that the idea of dividing the coils is not *new* as he supposes, nor has it been kept a secret, the same system having been proposed by me and roughly tried on an underground wire between Manchester and Liverpool so far back as May, 1873.

Two single current instruments were used, the coils being divided and connected up with continuity preserving keys, and worked successfully without either resistance coils or condensers.

I enclose a rough sketch, which will, I think, explain itself.

E. W. TURNER.

Liverpool, *5th March*, 1879.

[No mention is made in your letter or sketch of the moveable coil, which is a feature of Mr. Banker's system.—Ed. T. J.]

SIR,—If I correctly understand Mr. Banker's arrangement, a description of which appeared in your last number, there seems to be two objections to the system.

1. When the apparatus is not working both poles of the battery are to earth, having one of the relay coils in circuit.

2. The act of pressing down the key, *short circuits* the battery for an instant, and a current sent at the same moment from the opposite end of the wire is of itself insufficient to work the relay. The result would probably be a *splitting* of the marks.

Has the system ever been tried?

March 8, 1879. DETECTOR.

Notes.

THE ELECTRIC LIGHT.—The experiment with the electric light in Holborn has come to an end, and the City Commissioner of Sewers have recommended the report thereon to be printed.

THE lighting of the British Museum Reading Room by twelve Jablochkoff lights, on posts some 15 ft. above the floor, is another success, and has evoked the applause of the public. Last week the room was kept open for readers till 7 p.m. to test the light for reading purposes. A very faint hum is heard from the lamps; but it is soon disregarded. The smallest print can be easily read, and any flickering of the diffused light that there may be is not at all troublesome to the eyes.

THE cost of lighting the Albert Hall, which is fitted with four Siemens' lamps hanging from the dome and four Jablochkoff candles mounted on posts in the orchestra, fed by Siemens' new alternating current dynamo-electric machine, is stated at 12s. 6d. per hour, exclusive of interest on working capital.

THE British Electric Light Company have lit the Liverpool Landing Stage temporarily with electricity by means of two Gramme machines and two Serrin lamps. It is expected that ocean steamers will profit by this illumination of the Mersey. Several of the Havre and New York steamers now carry a flashing electric light at the mast-head.

MR. LATIMER CLARK, who to his other gifts adds that of lecturing, gave an admirable lecture on the electric light at the Eyre Arms, on March 5th. He was assisted by Dr. Muirhead, and all the well-known lights were exhibited. In his peroration Mr. Clark declared his firm faith in electric lighting as confined to streets and halls. He concluded: "How astonishing then are the wonders of electricity. How fortunate are we of this generation in being permitted to live in a period of such progress. Compare the world of to-day with what it was when many in this room were born—no gas, no steam-engines, no electric telegraphs, no photography, no railroads, no steamboats, no telephones or microphones. How proud ought we to feel, too, that our own little island has been the birthplace of most of these wondrous discoveries which have so changed the face of the world. Science has, doubtless, great triumphs in store for us; but, just as no previous generation has witnessed such advances as ours, so it is not conceivable that any future generation can see such stupendous changes as we have witnessed. The sceptre of the world has departed successively from India, from Egypt from Athens, and from Rome, ever travelling westward, and it may one day depart from Britain to travel still further towards the setting sun. But wherever it be found, as long as civilisation exists, and as long as mankind has a history, be it thousands or be it ten thousands of years hence, men, and even children, will be taught to speak with reverence of the day in which we now live—of the age of the great Queen Victoria—and to point out on the map the little sea-girt island in the northern seas, in which these wondrous discoveries had their birth."

THE TELEPHONE.—Gower's telephone, which we illustrated in our last, has been fitted up in the bureau of M. Cochery, Minister of Posts and Telegraphs, at the Havas Agency and at the *Société de l'eclairage electrique*, Paris.

WE hear that M. Du Moncel has brought out a new telephone.

MR. EDISON'S nephew has brought his uncle's new telephone to London. It is on the principle of the electro-motograph.

ADJUSTING BELL'S TELEPHONE.—It is well known that the Bell telephone requires adjustment from time to time owing to changes of temperature, humidity, and so on. This is ordinarily effected by means of a regulating screw which moves the magnet to or from the diaphragm; but as these screws have no indicator to them the work of adjustment is, to a certain extent, blindly done. A plan of regulation introduced by M. Champvallier, of the Ecole Artillerie, Clermont, France, has proved very convenient. It consists in fitting the regulating screw with a pointer and graduated circular scale; so that the best position of the screw-head can be marked. On adjusting the telephone separately to give the best hearing and speaking effects, and noting the corresponding positions of the pointer, a position midway between these two points is chosen.

SIEMENS' TELEPHONE CALL.—Dr. Werner Siemens forms a simple telephone call by inserting a whistle or reed pipe into the mouthpiece of the telephone when it is desired to call attention. On blowing into this whistle the sound agitates the telephone diaphragm in front of it.

A MICROPHONE CONCERT.—The wonderful invention, the microphone, has been put to a novel use in the city, experimentally. A few days ago Superintendent Eckert, of the Telephone Exchange, placed a microphone at each end of the stage of the Grand Opera House, and connected them with wires leading to the Central Exchange. Parties having lines in connection with the Exchange were notified that they would be treated to a novel concert, and at the appointed time a large number, in various parts of the city, took advantage of the invitation. The action of the microphones was marvellous. The most delicate strains of the orchestra were heard, and selections readily recognised. The words of the actors were distinguished, and, in some instances, the players voices recognised, so perfect was its articulation. Many in the suburbs of the city enjoyed the treat, and regarded the entire programme as very satisfactory, considering that no cost of admission was charged for the entertainment. This is a verification of the prediction we made some time ago. —*The American Inventor.*

THE PHONOGRAPH.—We hope to give an account of Messrs. Preece and Stroh's researches in vowel sounds in our next.

MAGNETISM AND POLARISED LIGHT.—An interesting experiment has recently been made by M. Henri Becquerel. Two rays of light polarised in the same direction were passed through a flint glass lens, which were subjected in opposite directions to the action of an electro-magnet, as in Faraday's experiment. On issuing from the lenses the two rays were brought into interference with each other; and it is observed that when the current passes in the electro-magnet the fringes are displaced in one direction, while when the current is stopped they are displaced in the opposite direction.

THE short cables from Newark to Heligoland and from Trinidad to Demerara are interrupted. Para is

reconnected to Pernambuco on the south, but no attempt has of late been made to restore communication with Cayenne and Demerara on the north.

THE CAPE CABLE.—The Eastern Telegraph Company have offered the Government the 1,400 miles of Australian cable now shipped, but the Government refused the guarantee against accident which the company stipulated for, and the negotiations were broken off. The India Rubber Company have offered to make and lay a cable within this year.

PUBLIC complaint has been made of the errors in the names of the killed and wounded in the Zulu war, as telegraphed from St. Vincent.

APROPOS of the Cape Cable, our French contemporary *L'Electricite* calls for cable communication between France and her colonies of Senegal and New Caledonia.

JAPAN TELEGRAPHY.—We learn from the *Journal Telegraphique* that Japan has joined the St. Petersburg Telegraph Convention, having adopted the extra-European rules and tax per word, without conditions as to minimum of words. The cost of a message in Japan is fixed at 40 Mexican cents., or about a shilling per word.

THE International Telegraph Conference will meet on June 10 in London, and not on June 2 as at first arranged.

FOR three years the German Telegraph Administration have published statistics of the faults on their air lines, a plan which is worthy of imitation by all other telegraph managements. In 1878 some 382 posts were broken on 17,700 kilometres of wire, 1,097 broken wires on 15,700 kilometres, 2,651 leakages on 34,500 kilometres, 1,342 damaged insulators on 25,000 kilometres, and 742 loose wires on 10,800 kilometres. These figures show a remarkable reduction of mishaps as compared with the previous two years.

TASMANIA has 850 miles of telegraph line connecting 46 stations, besides being connected by cable to Australia.

ELECTRIC CAR SIGNAL.—A trial will soon be made of a new signal recently patented by Mr. I. A. Sherman and Mr. C. E. Mees, of Louisville, Ky. The first-named gentleman is an accomplished electrician, and is connected with the Louisville and Nashville Railroad. The invention consists in combining a signal device upon the locomotive with two conducting wires extending through the cars of the train, and terminating at the end of each car in adjacent contact plates, forming seats, together with a flexible cable having two insulated wires terminating in metal plates separated by a soft rubber block, to continue the circuit, but permitting it to be broken when the cars separate, and transmit a signal to that effect to the engineer. It can be applied to freight as well as passenger cars. The cost will be something more than that of the system now generally in use.—*Nat. Car-Builder*, U.S.

CLERAC'S TUBE.—We are informed by Count Du Moncel that the reasons why he did not publish an account of Clerac's tube in his works are that M. Clerac is an officer of an administration which does not like its functionaries to publish their inventions, and because he (M. du Moncel) did not think that rheostats founded upon pressure did not give results constant enough to be classed as measures of resistance. The same degree of pressure on the same rheostat does not give the same resistance at all.

EFFECT OF INDUCTION CURRENTS ON THE SPINAL CORD.—Dr. William Miller Ord, Physician to St. Thomas's Hospital, has been investigating the effects of strong induction currents on the spinal cord of dogs. The dogs were killed by chloroform, and the cords being quickly exposed, were subjected to the currents for different periods and in different directions. Dr. Ord observed that the cord broadened in those parts through which the currents passed longitudinally, and narrowed where transverse currents were applied. The following are his conclusions as communicated to the Royal Society:—1. That, in young dogs, the protoplasmic constituent of the gray matter contracts *en masse* under the influence of strong faradaic currents. 2. That it contracts unequally and irregularly by reason of its unequal and irregular sectional area, causing thereby condensations at certain points—notably in the anterior horns and around the central canal—and rarefaction at others—notably in the middle of each crescent; such rarefaction going on sometimes to rupture of tissues. 3. That nerve-corpuscles contract in various degrees according to the strength and duration of currents, and that while they tend in contraction to become spherical they also tend to become vacuolated. 4. That the vessels are in some places strongly contracted and empty; in others dilated and filled with blood clot, having the appearance of embolus. 5. That the appearances correspond so decidedly with appearances in chorea and tetanus as to give ground for the supposition that contractions, such as are produced by electricity, do actually occur during life under the effect of nervous shock, and may be phenomena causal or associate of disease.

ELECTRICAL ENGRAVING.—M. Bellet has developed a plan for engraving by means of electricity. The drawing to be copied is placed over the metal plate, and a fine metal point emitting a succession of sparks capable of perforating the paper is caused to trace over the lines of the sketch. The discharge from point to plate severs the intervening paper. If, then, the greasy anti-corrosive fluid be applied to the surface of the paper, it will seek through and form lines on the metal plate following the lines of the drawing. On the application of acid to the plate, these greasy lines will protect the metal and form the salient parts of the engraving. Mr. Lascelles W. Scott has recently devised a somewhat similar electric pen.

ELECTROTYPING THE NERVOUS CENTRES.—The process by which M. Oré prepares his beautiful copies of brain and other nervous ganglions which attracted so much attention at the Paris Exhibition last year, has been described by him to the French Academy of Sciences. It consists in melting gutta-percha in a deep box, and plunging therein the brain or other organ to be modelled. The gutta-percha completely surrounds the object, and, on hardening in the air, it is cut into sections from each of which the brain matter is taken away, leaving a clean mould of gutta-percha representing the external form of the organ. The interior of this mould is then coated with plumbago, and an electrotype of copper or nickel made of it. This electrotype is thick enough after three or four days electro-deposition.

A ROYAL MEDAL has been awarded by the Royal Society to Mr. John Allen Broun for his investigations during thirty-five years in magnetism and meteorology.

TERRESTRIAL MAGNETISM.—One of the most remarkable results discovered by Mr. Broun is the fact that the

variations from day to day of the earth's daily mean horizontal force were nearly the same all the world over. He finds certain oscillations in these daily means which were due to the moon's revolutions and others having a period of twenty-six days: the latter he considers as due to the sun's rotation. It results from these investigations that the observed variations of the earth's daily mean horizontal force have been represented with considerable accuracy in all their marked features by the combination of the means calculated for these different solar and lunar periods. During the discussion of these periods Mr. Broun found that the great magnetic disturbances were apparently due to actions proceeding from particular points or meridians of the sun, a fact of very great importance. In meteorology he has shown the apparent simultaneity of the changes of daily mean barometric pressure over a great part of the globe, and he has likewise discovered a barometric period of twenty-six days nearly. He was also the first to commence and carry out during several years a systematic series of observations of the motions of clouds at different heights in the atmosphere; and, lastly, he has found certain laws connecting together the motions of the atmosphere and the directions of the lines of equal barometric pressure.

HÉRAUD'S BATTERY.—The poles of this cell are zinc and carbon, the exciting liquid hydrochlorate of ammonia, and the depolariser is mercurous chloride or calomel. When the circuit is closed, the hydrochlorate of ammonia forms zinc chloride with evolution of ammonia and hydrogen, which appear at the positive pole. The hydrogen reduces the calomel, producing metallic mercury, hydrochloric acid, and, consequently, hydrochlorate of ammonia. The zinc is suspended amidst the solution at a distance of several centimetres from the bottom. The carbon is, with its surrounding solution, contained in a linen bag, and the mercury, which is reduced at the carbon pole, falls by its weight through the linen to the bottom of the cell. In order to prevent evaporation of the ammonia, the cell is closed with an air-tight cork. The cell is held to be constant: its electromotive force after 246 days, during which it was used for a variety of purposes, being 66 per cent. of the original value. The original electromotive force is 1·45 times that of a Daniell element. The original resistance is given as equal to the resistance of 75 metres of telegraph wire.

HYDRO-ELECTRICITY AND HYDRO-MAGNETISM are the names given by M. C. A. Bjerknes, of Christiania, to certain attractions and repulsions observed by him between bodies in water. The bodies he experimented with were oscillating glass bells inverted in the water, and by means of tubes and an air-pump, pulses of air, causing pulsations in the water, could be sent into the bells. When the pulsations in the two bells were concordant, attraction ensued, when discordant, repulsion. A neutral or critical point was also observed in certain cases, and lateral deviation could also be produced. We do not see why this effect should be laid at the door of electricity since it appears to be quite mechanical.

INDUCTION IN TELEGRAPH WIRES.—M. H. de Meaux has pointed out in a note to the French Academy that the idea held by some electricians that a cylindrical conductor enclosing a wire, and in connection with "earth," is a protection against induction currents set up in the wire by currents travelling in neighbouring wires, is quite fallacious. The idea seems to have arisen from the assumption that electro-static induction is similar to electro-dynamic induction. M. Meaux points out the dissimilarity of the two phenomena. Fresh light was thrown upon this subject by Prof. Hughes at the Society of Telegraph Engineers' meeting on March 12.

Review.

The Speaking Telephone, Electric Light, and other recent Electrical Inventions. By G. B. PRESCOTT. London: E. & F. N. Spon.

IN writing this book, the author has had three objects before him: firstly to write a book, secondly to advertise Mr. Gray's claim to be recognised as the first and true inventor of the speaking telephone, and thirdly to support the claim of Mr. Edison to the discovery of the microphone. For a servant of the great telegraph monopoly of the United States, the Western Union Company, these are worthy enough objects when they can be effected without sacrificing truth or honesty of thought.

Mr. Prescott has already made a deservedly wide reputation as a writer of electrical works. His style is indeed not of the highest, nor is his grammar of the best, but it is sufficiently lucid for practical purposes, and he takes a vast deal of pains, and spares no expense, to turn out a comprehensive and well illustrated compendium of the matter he deals with. He thus renders a great service to students of electrical science, a service which we cordially applaud.

The present work contains much valuable information on the telephone, phonograph, and microphone, as well as on the electric light. Much space is occupied in presenting Gray's claims to the invention of the speaking telephone. His 1874 sulphuric acid and water telephone containing the idea of a speaking telephone, is illustrated first; then Bell's 1876 electro-magnetic telephone is illustrated, and the two are contrasted. Now, at page 71, in a foot note, it is implied that Bell only succeeded with his telephone when he applied the apparatus of Gray, invented two years before, and as the wording of the footnote is such that persons ignorant of the subject might attach greater importance to the statement than was perhaps intended, it should be pointed out that Gray's liquid telephone is not, and never was, a practical success, and that the electro-magnetic apparatus he employed was used only as a *receiver*, whereas the great merit of Bell's consisted in the use of an electro-magnetic *transmitter*, and making the speaking telephone an actual fact. Mr. Gray was probably the first to conceive of a theoretically correct speaking telephone; but to Bell belongs the honour of achieving one. More than this, Bell did not simply succeed, where Gray failed, by adding some happy improvement to Gray's plan. Bell's telephone was arrived at by a totally different line of reasoning, and further, it is a totally different instrument. Bell's is entirely electro-magnetic, Gray employs a battery. It was an *accident* that Bell's more successful transmitter happened to be like Gray's earlier receiver, not a plagiarism. Had the latter never existed at all, Mr. Bell would still have arrived naturally at that form, for it is simply the next refinement on the prior steel tongue apparatus. Once for all, Bell's telephone is quite a distinct system from Gray's, and what is more, it succeeded where Gray's failed.

Mr. Prescott fulfils the third object of his book in a far more sweeping manner than the second. It is amusing to find all the little experimental waifs and strays of Mr. Edison's carbon telephone researches marshalled by him in an imposing array, and dignified by the name of "microphone." This method of trying to establish a claim to an invention is more worthy of itinerant jugglery than of science.

At page 534 a sketch of Mr. Edison's carbon buttons is termed a "microphone," and we are told that "instruments of this nature have since become known as microphones, though it is *not probable that faint sounds were ever augmented throughout their agency, so that they could be easily recognised at a distance from their source*." We were about to inform Mr. Edison that the figure in question does not represent a microphone, but the passage we have italicised saves us the trouble. That passage shows too well that Mr. Prescott does not know what a microphone is, and has never heard one. If Mr. Prescott has not himself heard minute sounds transmitted to a distance by a real microphone, why does he also disbelieve all the high authorities in this country who have? It is his misfortune that he hasn't, but one would expect that the overwhelming testimony of Europe would satisfy him. At page 536 Professor Hughes' discovery of the microphone is stated in these words: "In May, 1878, Mr. Hughes, of London, published some interesting experiments based upon Mr. Edison's discovery of the variable resistance of solid conductors when subjected to pressure." In penning this significant passage Mr. Prescott has deliberately set aside the fact which has been abundantly forced upon his notice of late, that the real discoverer of that quality of carbon was M. Du Moncel, as far back as 1856, and the demonstration of Professor Hughes that he was led to the discovery of the microphone and the sonorous property of "bad joints," not by the discovery in question (a discovery too which Professor Hughes knew about before Edison had begun to invent at all), but by the stress of wires. It is a strange method this of writing a scientific treatise. Let us hope it is not common in America.

In his section on the electric light, Mr. Prescott is a safer guide than in the other parts of his book. But a book which is innocent of the beautiful lights of Rapieff and Werdermann cannot be said to do justice to the subject. There is nothing fresh about Mr. Edison's light.

THE ELECTRIC LIGHT IN PARIS.—The Municipal Council of Paris has arranged with the *Societe Generale* to try the Jablochkoff light for another year in certain parts of Paris, and with the Parisian Gas Company to try their gas lighting for a year in certain other parts. The *Societe* will have sixty-two candles in the Place and Avenue de l'Opéra, fifteen in the Place de la Bastille, and six in the Pavillon des Halles. The Gas Company will have fifteen lamps in the Rue du Quatre-Septembre, each of large size, and furnished with a crown of eight burners, consuming 1,400 litres of gas per hour; nineteen lamps in the Place du Château d'Eau having eight similar jets a-piece, and fifty-eight having four jets, consuming about 800 litres per hour; and twenty lamps of eight burners each in the Pavillon des Halles. A thorough competitive trial of gas *versus* electricity for street lighting will thus be obtained.

New Patents—1879.

644. "Magneto-electric or dynamo-electric machines." J. F. WILES. Dated Feb. 18.

684. "Improved means and apparatus for producing light by electricity." M. A. WIER. Dated Feb. 20.

740. "Improvements in electric lamps, and in the method of and apparatus for regulating and controlling the same." F. MORI, C. E. HALLEWELL, W. MILNER, W. GRIFFIN. Dated Feb. 24.

749. "A galvano-magneto-dynamo electric machine.' C. DUBOS. Dated Feb. 25.

781. "Electric telegraphs." E. A. COWPER. Dated Feb. 26.

783. "Obtaining electric light." G. P. HARDING. Dated Feb. 26.

792. "Improvements in electric telegraphs, and in apparatus connected therewith." Sir C. T. BRIGHT. Dated Feb. 27.

801. "Auto-kinetic electric telegraph apparatus." L. M. DE BEJAR Y O'LAWLOR. Dated Feb. 27.

805. "Improvements in and relating to magneto-electric apparatus." W. P. THOMPSON (communicated by W. W. Gary). Dated Feb. 28.

806. "Telephones." J. IMRAY (communicated by C. Ader). Dated Feb. 28.

827. "Electric telegraphs." R. and M. THEILER. Dated March 1.

830. "Improvements in and connected with electric lamps." G. G. ANDRÉ. Dated March 1.

854. "Producing and converting electric force into motive power." H. POST, T. VARLEY. Dated Mar. 4.

863. "Electric lamps." C. D. ABEL (communicated by J. C. JAMIN). Dated March 4.

876. "Mode of and apparatus for producing light by electricity." J. B. SPENCE. Dated March 5.

872. "Improvements in and connected with street and other fire alarms." R. S. SYMINGTON. Dated March 5.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

2193. "Apparatus for producing induced currents of electricity, specially applicable to transmitting signals, &c." A. F. ST. GEORGE. Dated June 1. 6d. This describes a telephone call, made by adding a second coil to the telephone, surrounding the first after the manner of the primary and secondary of an induction coil. A battery is connected up in series with the primary coil. The call is giving by starting a reed contact (which is in the primary circuit) into vibration.

2202. "Telephones." W. H. PREECE. Dated June 1. 6d. This consists in a method for transferring the received vibrations of a tone telephone to membranes in such a way as to increase the volume of sound given out. This is done by connecting the end of the vibrating reed of the tone telephone (which may be the elongated tongue of a polarised relay) to a tight membrane by means of a stretched wire, as in the toy telephone. More than one of these membranes or

tambours may be vibrated from the same receiver in this way.

2281. "Distributing and regulating electric currents to work lamps." C. W. SIEMENS. June 7. 6d. This describes Siemens' current regulator, which we illustrated in last number.

2288. "Apparatus for refracting, reinforcing, and modulating sound." A. C. ENGERT. Dated June 7. 6d. This consists of the application of iron or other hard material in sheets, or spiral coils supported by spiral springs from the sounding body.

2385. "Electric telegraphs." E. A. COWPER. Dated June 15. 6d. This describes Cowper's telegraphic pen, which we illustrated in last number.

2396. "Telephones and apparatus employed in electric circuits." T. A. Edison. Dated June 15. 10d. This describes the telephone, in which a plate or body, against which the sound waves in the atmosphere act, is placed against a button of carbon in circuit with the line, so that the pressure of the waves on the plate vary the resistance of the carbon. Edison's microtasimeter is here also described. (See TELEGRAPHIC JOURNAL, Nov. 15th, 1878.)

2399. "Obtaining light by electricity." W. P. THOMPSON (communicated by E. Reynier). Dated June 17. 6d. This describes Reynier's well-known electric lamp, in which a fine rod of carbon impinges on a rotating disc, the result being a very small arc or bead of light.

2401. "Apparatus for producing electric light." C. DUBOS. Dated June 17. 6d. This describes an electric lamp in which the wasting carbon is carried by an iron tube free to move in a hollow electro-magnet. The regulation is effected by passing the current feeding the light through the coil, and balancing the downward weight of the carbon against the upward pull of the electro-magnet on its iron holder. *Not proceeded with.*

2407. "Manufacture of articles produced by the electro deposition of metals." W. R. LAKE (communicated by J. W. Tufts, Medford, Mass., U.S.). 6d. This consists in freeing electrotypes from ragged edges by running a ridge round the border of the mould, which gives a corresponding groove in the electrotype. The latter is trimmed of its rough edge by cutting through this groove from the back.

2451. "Apparatus for lighting." MM. FRANZINI, Naples. Dated June 20. 6d. To increase the light from a lamp a semi-spheroidal water lens is placed in front and a whitened glass reflector behind.

2456. "Telephony." H. J. HADDAN (communicated by A. Mulhalland, Toronto). Dated June 20. 2d. This consists in the combination of a "condenser" with a telephone, in order to utilise a telegraphic circuit as a telephone line, without interfering with the use of the line for ordinary telegraphing; and in "earthing" a telephonic circuit at various points through a condenser in order to diminish the effect of external induction. *Not proceeded with.*

2467. "Electro-magnetic clocks." C. SHEPHERD. Dated June 20. 1s. To prevent stopping of electric clocks in event of the current failing, two or more separate circuits are arranged in connection with a single pendulum, each being capable of keeping the clock going, so that if one fails the other will suffice.

2477. "Apparatus for electric lighting." R. WERDERMANN. Dated June 21. 8d. Werdermann's electric light was fully described in the TELEGRAPHIC JOURNAL for Nov. 15th, 1878.

2554. "Telegraphic apparatus." C. A. BRAMÃO, Lisbon. Dated June 26. 8d. This consists of a double current electro-magnetic ink-writer, in which the armature moves to right and left of its zero position, forming right and left deviations of the zero line on the paper as in the siphon recorder.

Proceedings of Societies.

PHYSICAL SOCIETY.—MARCH 8th, 1879.

Prof. W. G. ADAMS in the Chair.

A new theory of the earth's magnetism was brought forward by Professor Ayrton which we give on another page.

Dr. J. Hopkinson then read an account of some experiments with the Quadrant Electro-meter, which showed that Clerk-Maxwell's formula for the sensibility of the electro-meter $(A - B)\left(C - \frac{A+B}{2}\right)$, where A and B are the potentials of the two pairs of quadrants, and C the potential of the needle, only holds good when C (the charge of the jar or needle) is less than 200 Daniell elements; above that a different law appears to hold. Dr. Hopkinson also remarked that any degree of low sensibility down to zero could be got from the electrometer by connecting a condenser to each pair of quadrants and adjusting their capacities.

Mr. F. D. Brown described his apparatus for maintaining constant temperatures and pressures. A constant temperature can be obtained if the pressure can be kept constant. The vessel in which the constant pressure is desired, communicates with an air pump by a pipe in which a moveable tap or valve is placed. By opening or closing this tap the pressure is regulated. This is effected by an electric clutch arrangement. A mercury anemometer sends a positive or negative current from a battery through the clutch according as the pressure is too high or low, and this current actuates the clutch to close or open the valve. The clutch consists of an axle driven by a turbine to get power to work the valve, and the current by means of electro-magnetism connects the tap to the axle, which then opens or closes it, as the case may be. In this way a pressure, varying no more than one-fifth millimetre each way can be obtained.

General Science.

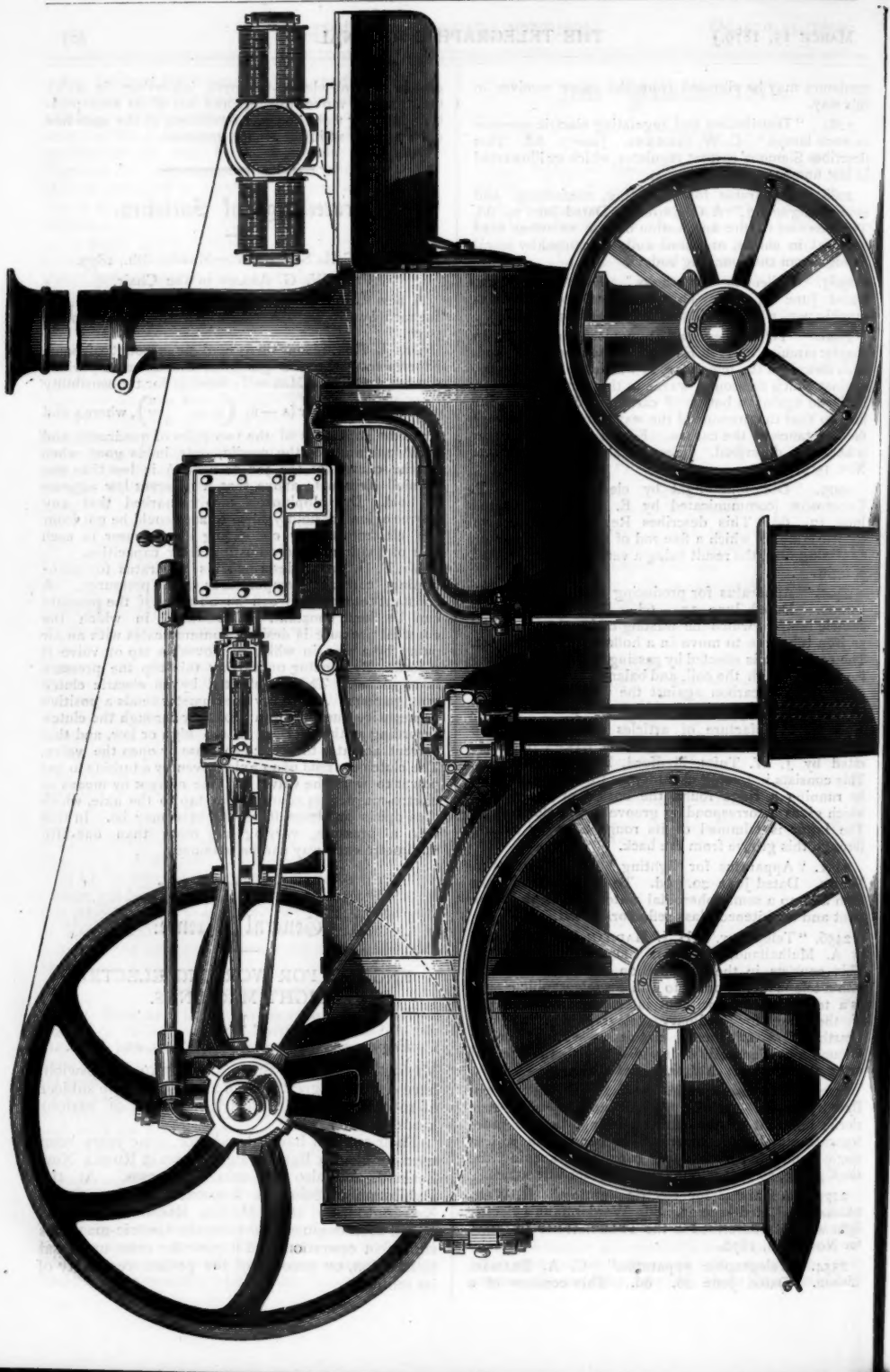
ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

II.

Engines of Messrs. Ransomes, Sims, and Head.

MESSRS. RANSOMES, SIMS, AND HEAD, of Ipswich, have devoted a great deal of attention to the subject of motive power for electric-machines of various kinds.

Their engines have already for some years been used for electric light for lighthouses in Russia, New Zealand, and also for other purposes. At the Exhibition of Scientific Apparatus, held at South Kensington, in 1876, Messrs. Ransomes supplied one of their engines for driving the electric-machines shown in operation, and it gave the most universal satisfaction, on account of the perfect regularity of its motion.



It is well known that, in all cases, the greatest regularity in speed is required in the motive power for all electric-machines, and for this purpose Messrs. Ransomes recommend their Patent Automatic Governor Expansion Gear, which will regulate the movement of the engine to such a nicety, that the revolutions will remain without any perceptible fluctuation, even when the entire load is suddenly put on or thrown off. As it has also been found better in all cases to employ a small separate steam engine for the electric light, rather than to drive the machinery from the main engine or running shafting of the factory, Messrs. Ransomes have been induced to pay great attention to the adaptation of their portable engines for electric purposes.

The engraving (fig. 1) represents one of Messrs. Ransomes, Sims, and Head's portable engines, which has been recently designed, and is specially arranged for driving a dynamo-machine. The electric-machine is carried on a bracket extended beyond the smoke-box, so that the whole apparatus, motive power, and electric-machine is self-contained, and being mounted on the four wheels of the engine, it is readily transported from place to place. The

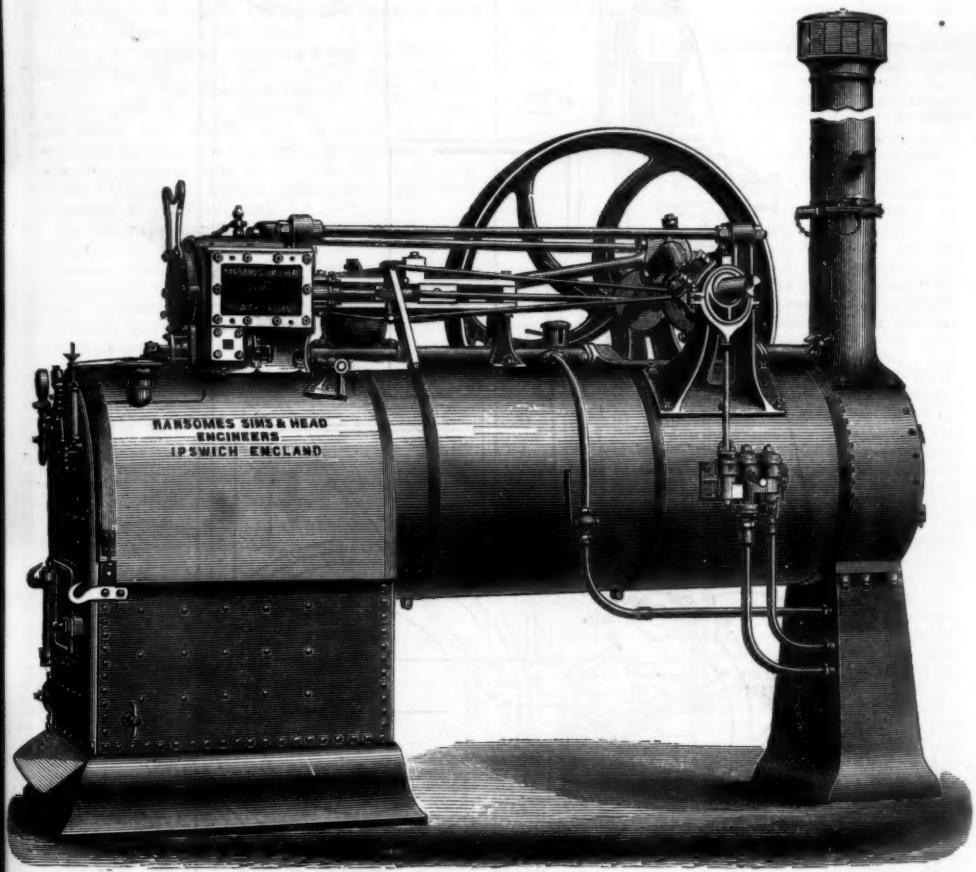


FIG. 2.

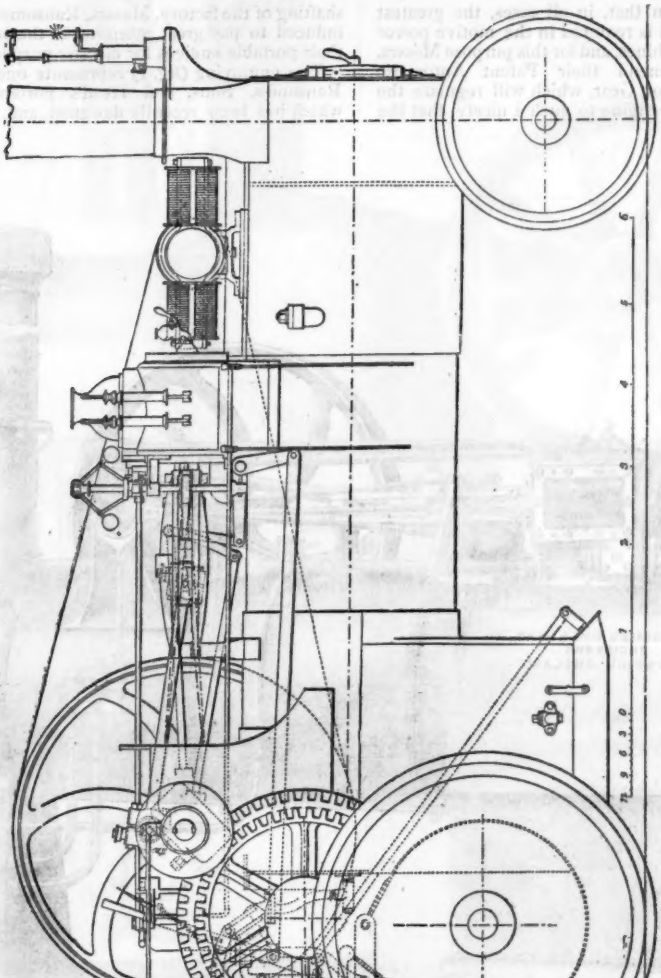


FIG. 3.

platform can be arranged, when required, to carry an exciter and distributor, so that, by fitting on a second fly-wheel, both machines may be driven at one time.

It will be noticed that in this arrangement the cylinder has to be placed next the funnel, and the crank-shaft over the fire-box; but Messrs. Ransomes have also supplied engines of their standard pattern, in which a bracket for the dynamo-machine is fixed on the side of the fire-box, or they can attach a bracket to each side of the fire-box, so as to drive two machines at the same time.

The 6 horse-power machine, which we illustrate, has a cylinder 8¼ in. in diameter, with 12 in. stroke, and a speed of 140 revolutions a minute. With a steam pressure of 80 lbs. per square inch, cut off at about half-stroke, this engine will develope about 30 indicated horse-power, and the coal consumed under ordinary circumstances would not be more than about 3 lbs. per indicated horse-power per hour, according to quality of coal.

For the experiments now being carried on by the Metropolitan Board of Works in lighting the Thames Embankment by electricity, Messrs. Ransomes have supplied a 20 horse-power portable steam engine, which is fitted with the patent automatic governor, and has been much approved, and the excellent working and regularity of motion in this engine has contributed greatly to the success which has thus far attended the experiments in question.

This engine has two cylinders each of 10 in. diameter, with 13 in. stroke, and makes 140 revolutions a minute. It is mounted on cast-iron pedestals or saddles, instead of wheels, which gives great steadiness.

The engraving (fig. 2) shows one of Messrs. Ransomes' simple cylinder engines on pedestals, and fitted also with the patent automatic governor expansion. These engines are made from 4 to 20 horse-power, and they may all be had either on wheels or on pedestals.

The engraving, fig. 3, shows Messrs. Ransomes' Traction Engine (as used for agricultural purposes) arranged for driving an electric light for railway purposes. The ordinary wheels have been replaced by flanged wheels to suit the rails and the engine, which is of very light but strong construction, and can be run from place to place at speeds of 1½ or 3 miles an hour. This arrangement of railway engine and light will be found most useful for lighting up works at night on the permanent way, or for repairs, or inspection of tunnels. The dynamo-machine is fitted to the front part of the boiler between the cylinder and furnace, and is driven by strap from the fly-wheel. The light which may be of any system preferred, is intended to be placed in front of the smoke box at a height most convenient.

When the engine is travelling on the line the dynamo-machine is driven by the strap from fly-wheel as before mentioned, and the light is diffused along the road. When, however, it is necessary to stop in order to direct the light to some particular spot, the driving wheels are readily thrown out of gear, so that the engine ceases to be locomotive, the power being employed only for driving the dynamo-machine.

During the day the engine can be used for driving saws or pumping, or any other description of work.

City Notes.

Old Broad Street, March 12, 1879.

ON the 4th inst. the fifteenth annual ordinary meeting of the directors and shareholders of the Telegraph Construction and Maintenance Company (Limited) was held at Cannon Street Hotel, Sir Daniel Gooch, Bart., M.P., chairman, presiding. The report, in addition to the facts mentioned in the abstract contained in our issue of March 1, mentioned that the principal operations carried out by the company during the year 1878 were:—The laying of two sections of the Western and Brazilian Telegraph Company's cables on the coasts of Para and Maranham in the Brazils, amounting to 565 nautical miles, in accordance with the terms of a contract entered into with that company. An endeavour to repair the Anglo-American Company's cable of 1866, which proved unsuccessful, the decayed condition of portions of the outer covering rendering it impossible to raise the cable, except in short lengths. Two of the company's ships were employed on this operation between May 25 and July 27. The manufacture and laying of a cable for the Eastern Telegraph Company between the island of Cyprus and Alexandria, and the manufacture of certain lengths of cable to enable the company to duplicate and connect up portions of their system with the islands of the Levant and Constantinople. The manufacture of 289 miles of cable for Her Majesty's Government. The total quantity of cable manufactured during the year was 2,631 miles. The North Woolwich works, lately the property of W. T. Henley & Co. (Limited), and on which this company held the first mortgage, had been legally transferred to, and were now in possession of the company. The shares of the Black Sea Telegraph Company had been transferred to the Eastern Telegraph Company, and the cable from Odessa to Constantinople now formed part of its system. The company's debentures had been renewed on the same terms for a period of five years from January 1, 1879. The factories at Wharf Road and East Greenwich were in thorough working order. To replace the steamship *Hibernia*, the steamship *Scotia* had been purchased, and she, together with the *Calabria*, was undergoing extensive alterations and improvements, which, when completed, would place the company in possession of four large and efficient vessels, equal to the performance of any cable-laying operations that might offer.—The Chairman moved the adoption of the report.—Mr. Rawson (Director) seconded the motion.—Mr. Abbott, having complained that the chairman was difficult to draw out, said he would like to see a portion of the large balance added to the reserve fund.—The Chairman pointed out that their success had depended on their having the free use of large floating capital, and asked what would be the use of putting money in the reserve fund only to draw it out again.—Dr. Laurie: I want to know whether the company has received a commission for laying down cables to South Africa.—The Chairman: The Board are not able yet to supply details in matters of that kind. Negotiations have taken place, and are in progress. What the result will be you will know later on. At present there is no final agreement. (Hear, hear.)—The motion having been carried, Sir George Elliot, Bart., and Mr. Philip Rowson, the retiring directors, were re-elected, and Mr. J. Ball and Mr. Gane were appointed auditors for the year ensuing.—Before the meeting separated the secretary made an announcement relative to the second bonus trust, stating that there remained in the hands of the bankers £1,000 on this account, and the supplementary sheet of coupons could be obtained at the office.

The board of directors of the Indo-European Telegraph Company (Limited) determined at their meeting on the 10th inst. to recommend to the shareholders the payment of a dividend for the six months ending December 31, 1878, of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year 1878, free of income tax; the dividend to be payable on and after the 1st of April next.

The report of the directors of the Direct United States Cable Company, Limited, for the six months ending 31st December, 1878, to be presented at the Third Ordinary General Meeting of the company, states that "the revenue for the half-year, after deducting out-payments, amounted to £89,943 14s. 8d. For the corresponding half year of 1877, the amount of revenue, after similar deductions, was £84,217 12s. 10d. The working and other expenses, interest on debentures of the old company and income tax, amount to £21,748 9s. 11d., leaving a balance of £68,195 4s. 9d. as the net profit for the half-year, making, with £2,933 3s. 7d. brought forward from the previous half-year, a total of £71,128 8s. 4d. In the corresponding half-year of 1877, the expenses and payments above mentioned, and cost of repair incurred during that period, amounted to £25,046 2s. 10d. Interim dividends of 1¼ per cent. each of the quarters ending 30th September and 31st December, 1878, together amounting to £30,355, have been declared and paid. A sum of 32,500 has been added to the reserve fund (thereby increasing it to £73,139 14s. 9d.), and a further sum of £3,000 has been written off the preliminary expenses, leaving a balance of £5,273 8s. 4d., which has been carried forward. The debentures of the old company have been paid off. The arbitration proceedings between the liquidators of the old company and Mr. Loeffler, one of the dissentient members, have extended over a period of 10 months. It is with much satisfaction the Directors state that the proceedings were closed on the 5th February last, and they now await the Arbitrator's award. The Muirhead Duplex System has been applied to the main cable." The meeting is to be held on 21st inst., at the City Terminus Hotel, Cannon Street, at twelve o'clock noon, precisely.

The Secretary of the West Coast of America Telegraph Company notifies that, in consequence of the difficulties which have lately arisen between the Governments of Chili and Bolivia, the West Coast of America Telegraph Company (whose cables now stretch from Lima to Valparaiso) have been requested to connect the Bolivian port of Autofagasta with their present system, thus placing Bolivia in telegraphic communication with the rest of the world. As this company's telegraph ship is now on the coast, with sufficient cable on board, the connection is expected to be completed within a few days.

The Stock Exchange Committee have allowed 3,000 £10 (fully paid) shares of the India Rubber, Gutta Percha, and Telegraph Company to be added to the 28,200 shares already quoted.

In our last issue we mentioned that there were but two cables working across the Atlantic, and that both were duplexed; this is slightly incorrect, one only of the two being duplexed, viz., that by the Stearns' system.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 57-57¼; Ditto, Preferred, 86-87; Ditto, Deferred, 29-30; Black Sea, Limited, —; Brazilian Submarine, Limited, 6¾-7; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15-15½; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 10½-10¾; Direct United States Cable, Limited, 1877, 11⅛-11⅜; Eastern, Limited, 7¼-7⅜; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1878, 100-103; Eastern, 6 per cent. Preference, 11⅛-11⅜; Eastern Extension, Australasian and China Limited, 7¼-7⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 104-107; German Union Telegraph and Trust, 7⅞-8½; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 10¼-10½; Great Northern, 8⅛-8⅜; Indo-European, Limited, 20½-21½; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 9½-10½; Submarine, 215-225; Submarine Scrip, 1⅝-2⅛; West India and Panama, Limited, 1⅝-2⅛; Ditto, 6 per cent. First Preference, 8½-9; Ditto, ditto, Second Preference, 7⅞-8¼; Western and Brazilian, Limited, 4-4¼; Ditto, 6 per cent. Debentures "A," 92-96, Ditto, ditto, ditto, "B," 87-92; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 100-102; Telegraph Construction and Maintenance, Limited, 31½-31⅝; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2½-2¾; India Rubber Co., 10½-11.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£ [b]	£	£	£ [b]	£
February, 1879	42,540	12,558	2,800	784	14,180	37,251	22,409	12,087	... ...	8,658	2,400	... ...	4,940
February, 1878 ...	43,470	9,676	2,818	814	10,010	41,831	20,716	12,725	... ...	9,257	1,425	... ...	5,123
Total Inc., 1879	... ...	2,882	... ...	... ...	4,170	... ...	1,693	... ...	... ...	... ...	975	... ...	... ...
Total Dec., 1879	930	... ...	18	30	... ...	4,580	... ...	638	... ...	599	... ...	... ...	183

[b] Not published.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)